PART 4. SCIENCE VALIDATION

5. CONCLUSIONS

For the EO-1 mission, the following science validation conclusions are reached:

1. Formal mission science validation analysis has proven to be extremely successful.
    - 1.1 Hyperion and ALI based surface reflectance have been successfully retrieved and validated by the Science Validation Team.
    - 1.2 ALI band 5p has proved to be extremely useful for vegetation analysis.
    - 1.3 ALI technology provides a viable path to Landsat data continuity.

2. ALI has been shown to be a significant improvement over Landsat ETM+ due to additional bands, better dynamic range, and higher signal/noise ratio (SNR).
    - 2.1 In general, use of ALI data results in higher classification accuracies and provided better discrimination than possible with ETM+ for a variety of vegetation applications.
    - 2.2 ALI pan-band and improved SNR allow significantly better mapping of vegetation, ice, and hazard assessment than is possible with Landsat 7 ETM+. ALI ice-sheet investigations provided quantitative measure of flowstripe relief and detection of sastrugi not possible with ETM+. Cloud/snow discrimination is a problem because of lack of a thermal band on ALI.
    - 2.3 ALI is better than ETM+ for assessing temperature of active volcanoes. This is due to the larger number of SWIR bands and improved SNR.
    - 2.4 ALI band 1p is useful for characterizing clear/hazy regions.
    - 2.5 ALI band 1p and improved SNR shows promise for coastal and ocean applications.
    - 2.6 Studies have shown that ALI estimates of vegetation cover (Leaf Area Index) are as accurate as those of ETM+.
    - 2.7 ALI is as accurate as ETM+ in mapping urban surface materials in the SVT studies conducted.
    - 2.8 ALI is superior to ETM+ for mapping feature boundaries and texture largely due to the high SNR and well co-registered pan-band.
    - 2.9 ALI forest classification is typically better than ETM+ (e.g. 85% vs 75%).
    - 2.10 The inclusion of ALI band 5p in classification leads to improved discrimination of woodland classes.
    - 2.11 ALI calibration appears stable and SNR is higher than ETM+.

3. Space-borne hyperspectral imaging provides assessments needed for meeting essential Earth Science Enterprise (ESE) and national monitoring goals not achievable through multispectral observing systems. Hyperion has validated the utility of orbital imaging spectroscopy. The Hyperion instrument has demonstrated the following significant features:
    - 3.1 Significantly better characterization of semi-arid, agricultural, and selected forest regions than provided by ALI and ETM+.
    - 3.2 Superior performance than from multispectral systems in detecting invasive species (e.g. leafy spurge and tamarisk).
    - 3.3 High effectiveness in estimating carbon stock by allowing decomposition of landscape components into live vegetation cover, dead biomass, and soil background.
    - 3.4 Some success in discriminating Benthic community (coral, seagrass, and algae).
    - 3.5 Geological mapping ability suitable for a variety of scenarios (Hyperion mineral mapping is consistent with AVIRIS but is limited by lower SNR).
    - 3.6 Sufficient spatial resolution, spectral resolution, and SNR to map hydrothermally altered rocks from space (low SNR is a problem for low sun angles).

3.7 A quantitative look at “hot spots” including volcanoes and forest fires is not possible with multispectral systems.

Other findings are as follows:

3.8 Hyperion spectral bands allow for complete numerical solution of the lava flow field temperature distribution.

3.9 Full spectral content allows for improvement in target characterization in spite of poor SNR for some applications.

3.10 Hyperion does a better job assessing various levels of forest damage than ALI or ETM+.

3.11 Hyperion can resolve and map ice sheet grain size and provide estimates of albedo.

3.12 Full spectra content of Hyperion data permits us to do a better job of atmospheric correction than is possible for multispectral data.

3.13 Hyperion has improved ability to map fuel condition and fuel moisture in fire susceptible regions as compared to ALI and ETM+.

3.14 AVIRIS has demonstrated that hyperspectral data can be used to accurately map canopy nitrogen content. Coincident observations have demonstrated that Hyperion can be used to derive canopy nitrogen with somewhat less accuracy due to the decreased SNR.

3.15 Hyperion data can successfully be used to synthesize multispectral data (demonstrated direct comparison against ALI and ETM+).